

# An Investigation of Factors Influencing the Implementation of Cloud Computing by SMEs

Jesse Atuah<sup>1</sup>, Stephen Akobre<sup>2</sup>, David Sanka Laar<sup>3</sup>,  
Peter Awonnatemi Agbedemrab<sup>4</sup>

<sup>1,2,3,4</sup>School of Computing and Information Sciences, C. K. Tedam University of Technology and Applied Sciences, Navrongo, Ghana

## ABSTRACT

Cloud Computing has emerged as a groundbreaking technology with widespread impact, bringing advantages such as low initial costs, cost-effectiveness for intermittent use, ease of management, scalability, device and location independence, and rapid innovation to businesses of various scales. Despite the benefits of implementing Cloud Computing, SMEs are yet to fully embrace it. To increase cloud implementation rate there is the need to investigate the key factors that influence its implementation by SMEs. The study employed the TOE framework to identify factors that have great influence in cloud implementation through a literature review and a survey of selected SMEs. A closed ended questionnaire was developed to ascertain these factors within the context of Bolgatanga by engaging key stakeholders, including ICT managers, CEOs/General Managers, and Admin/Accounts personnel, of selected SMEs to provide insights into the study. The study reveals that relative advantage holds the most significant influence among various factors, such as compatibility, top management support, competitive pressure, and regulatory support, across technological, organizational, and environmental categories in the cloud implementation process. This underscores the importance for SMEs to prioritize effective communication especially the benefits of cloud technology to stakeholders. This would pose a great deal for SMEs to implement cloud thereby enhancing business operations.

**Keywords:** Cloud Computing, Small and Medium Enterprises (SME), Framework, National Institute of Standard and Technology (NIST), Information Technology (IT).

## INTRODUCTION

A unique technology that has gained substantial traction in recent years is Cloud Computing. Cloud Computing offers SMEs the ability to access Information Technology (IT) resources and services on-demand. According to [1], Cloud Computing is a service-oriented model within the field IT, offering customers on-demand access to computing services via a network in a self-service manner, regardless of the device or location. NIST defines cloud computing as a model that encompasses three main services, each offering a set of five core competencies such as include On-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service. The three services identified by NIST are Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). These services provide different levels of abstraction and functionality to users according to [2]. In comparison to traditional IT, cloud computing exhibits distinct characteristics such as ubiquity, elasticity, resource

sharing, data concentration, cost-effectiveness, and pay-per-use [3]. As technology evolves SMEs in Bolgatanga are still lacking behind in terms of implementing cloud computing, they are still resorting to using traditional IT despite the challenges posed by the traditional IT setup. It has therefore become incumbent for experts in the domain of information technology to investigate the factors that SMEs would consider as influencers in implementing cloud computing in their operations. This study therefore sought to investigate the factors that influence cloud computing by SMEs.

## **RELATED RESEARCH WORK**

### **SMEs and Cloud Computing**

Cloud Computing has become increasingly strategic for midsize businesses and is increasingly integrated into business strategy. SMEs are reluctant to adopt cloud computing, despite concerns expressed by industry experts [4]. Especially in the current global recession, where many small businesses are struggling to survive, cloud computing offers an opportunity to improve efficiency and technology utilization without the need for extensive staff training. SMEs often deal with sensitive data, including intelligence data, financial information, contracts, research data, trade secrets, etc. [5]. Cloud-based technologies offer SMBs several advantages, including low initial costs, cost-effectiveness for intermittent use, ease of management, scalability, device and location independence, and rapid innovation [6]. According to [7], it saves costs associated with hardware purchases, maintenance, software, system upgrades, data storage, and licensing. Cloud computing also enables incremental improvements to business processes without disruptive transformation, offering strategic advantages to small businesses [8].

### **Technology-Organization-Environment (TOE) Framework**

[9], first developed the Technology, Organization, Environment (TOE) framework, which defines technology acceptance within organizations as well as how technological, organizational or environmental contexts influence how technological advances are implemented [10]. TOE includes all stages of innovation: from idea generation by entrepreneurs or engineers to adoption and implementation within companies' contexts.

### **Technology**

The technology is composed of both internal and external technological devices and processes [11]. An organization's technology strategy describes the technologies it currently utilizes, its characteristics, and what may be suitable in the future [12]. Effective utilization of both internal and external technologies is essential for increasing productivity within an organization [13] noted that SMEs utilize technology to increase productivity efficiency and effectiveness.

### **Organization**

The organization refers to the internal qualities of a business that may hinder the adoption of cloud computing [14]. [15], identified organizational appearances as having the greatest effect on decision-making regarding modernization: formal and informal structures linking communication processes, size, and latent resources [10]. In this study, variables related to top management support, employee engagement, perceived profits, company size, and financial commitment were proposed as variables within this framework [16].

## **Environment**

The setting refers to the physical location where a corporation performs its operations, including employees, stakeholders, and management. It lies outside of an organization's boundaries and presents both limitations and possibilities for technological progress. This makes the TOE framework widely applicable across various fields as scholars can tailor each element according to innovation needs or organizational traits such as work [5]. The outcomes from TOE analysis then serve as inputs to strategic decision-making processes.

## **METHODOLOGY**

### **Research Approach and design**

The study employed a quantitative approach to collect data, aiming to gain insights from various key stakeholders within the enterprises.

### **Data collection Method and Instrument**

The primary data sources for this study encompassed various stakeholders within small and medium-sized enterprises (SMEs) in Bolgatanga. General managers, ICT managers, Admin/accounts of selected SMEs were used to collect data using closed ended questionnaires

### **Sample and sampling technique**

According to [17], purposive sampling is a sampling technique where the selected individuals, as research participants are knowingly chosen because of their suitability for advancing the purpose of the research. By employing this sampling technique, the sample size obtained was a total of twenty-two (22) SMEs with a sample size of fifty-two (52) representing Nineteen (19) CEO/ General Managers, twenty (20) IT managers and lastly, thirteen (13) Accounts/ Admin officers.

### **Data Analysis**

The data collected was screened to make sure it was valid and error free. Frequencies and percentage were computed to describe demographic information of participants while the standard deviation and mean were computed to determine the predominant factors influencing cloud computing by SMEs. The Statistical Package for the Social Sciences (SPSS) was utilized to analyze the data.

## **RESULTS AND DISCUSSION**

### **Demographic Information of Participants**

The demographic information pertaining to the participants covered sex, age, enterprise sector, job title. The data is indicated in Table 1. Out of a total of 52 respondents, 75% were males and 25% participants were females. Also 32.7% were between the ages of 31-36 and formed the majority while 21.1% was between 19-24 years, constituting the minority. The data of the enterprise sector were as detailed, retail/wholesale sector and financial sector constituted 17.3% each of the participants. The healthcare sector, constituting 7.7% of the participants. Education and the information technology had each, representing 17.3% of the total. The hospitality sector accounted for 17.3%. Furthermore, the manufacturing sector constituted 9.6%. The participants' job titles were classified into different categories. Among the respondents, 19 individuals held the position of CEO/General Manager, representing 36.5%, 20 participants were IT managers, accounting for 38.5%. Admin/Accounts constituted 13 participants,

representing 25.0%.

Items	Frequency	Percentage (%)
<b>Sex</b>		
Male	39	75.0
Female	13	25.0
<b>Age of respondents</b>		
19-24 years	9	17.3
25-30 years	9	17.3
31-36 years	17	32.7
37 and above	11	21.1
<b>Enterprise Sector</b>		
Retail/Wholesalers	9	17.3
Financial service	9	17.3
Healthcare sector	4	7.7
Education	9	17.3
Information Technology Sector	7	13.5
Hospitality	11	17.3
Manufacturing	5	9.6
<b>Job Title</b>		
CEO/General Manager	19	36.5
IT Manager	20	38.5
Admin / Accounts	13	25.0
5years and above	5	9.6
<b>Grand Total</b>	<b>52</b>	<b>100</b>

**Table 1: Demographic information of participants**  
**Source: Field Data (2023)**

Table 2 presents the outcomes pertaining to the factors that influence the successful implementation of cloud computing. These results are accompanied by their corresponding means and standard deviations (SD).

Item	Mean	SD
<b>TECHNOLOGICAL FACTORS</b>		
Relative Advantage	4.36	0.89
Compatibility	4.0	0.99
<b>Average</b>	<b>4.18</b>	<b>0.94</b>
<b>ORGANISATIONAL FACTORS</b>		
Top Management Support	4.09 <sup>4</sup>	0.96

<b>Average</b>	<b>4.09</b>	<b>0.96</b>
<b>ENVIRONMENTAL FACTORS</b>		
Competitive pressure	3.78	1.08
Regulatory Support	3.75	0.93
<b>Average</b>	<b>3.77</b>	<b>1.01</b>

**Table 2: Factors that influence the implementation of Cloud computing by SMEs**  
**Source: Field Data (2023)**

From Table 2, of the Technological factors, the mean score for Relative Advantage is 4.36 with a standard deviation of 0.89. Compatibility as a technological factor has a mean score of 4.00 and a standard deviation of 0.99, highlighting the need of aligning cloud solutions with existing systems and processes. On average, technological factors received a mean score of 4.18, with a standard deviation of 0.94. Also under organizational factors, Top management support has a mean score of 4.09 and a standard deviation of 0.96, when considering the average score for organizational factors, it remains consistent at 4.09, with a standard deviation of 0.96. Lastly, under environmental factors, competitive pressure, has a mean score of 3.78 and a standard deviation of 1.08. Similarly, regulatory support, with a mean score of 3.75 and a standard deviation of 0.93. The average mean score for environmental factors is 3.77, with a standard deviation of 1.01. The primary driver behind the implementation of cloud computing among SMEs, as indicated by the data, is attributed to Technological Factors, specifically the concept of relative advantage, which obtained the highest average score of 4.36. This discovery is substantiated by previous studies [18, 19], which also highlight relative advantage as a significant factor influencing the implementation of cloud technology within the SME sector.

## CONCLUSION AND RECOMMENDATION

The research discovered that the primary factor influencing cloud implementation among SMEs in Bolgatanga is Relative Advantage, alongside factors like Compatibility, Top Management Support, Competitive Pressure, and Regulatory Support. Since Relative Advantage emerged as the predominant factor influencing cloud implementation, SMEs should focus on communicating the benefits and advantages of cloud technology clearly to all stakeholders. Developing targeted communication strategies can help SMEs underscore the advantages that cloud implementation brings to their operations.

## SUGGESTIONS FOR FUTURE WORKS

The researchers strongly recommend conducting a replication of the study across other regions, while also increasing the sample size significantly. This will greatly enhance the generalizability of the findings, making them more applicable to a wider population. Future work should cater for developing practical framework for cloud implementation for SMEs based on the identified factors so as to allow SMEs to leverage on the cloud services.

## References

1. Sean Marston, Zhi Li, Subhajyoti Bandyopadhyay, Juheng Zhang, and Anand Ghalsasi. Cloud computing—the business perspective. *Decision support systems*, 51(1):176–189, 2011.
2. Peter Mell, Tim Grance, et al. The nist definition of cloud computing. 2011.

3. Michael Armbrust, Armando Fox, Rean Griffith, Anthony D Joseph, Randy Katz, Andy Konwin- ski, Gunho Lee, David Patterson, Ariel Rabkin, Ion Stoica, et al. A view of cloud computing. *Communications of the ACM*, 53(4):50–58, 2010.
4. Prashant Gupta, Arumugam Seetharaman, and John Rudolph Raj. The usage and adoption of cloud computing by small and medium businesses. *International journal of information management*, 33(5):861–874, 2013.
5. Iqbal Ahmed. Technology organization environment framework in cloud computing. *TELKOM- NIKA (Telecommunication Computing Electronics and Control)*, 18(2):716–725, 2020.
6. Muhammad Adeel Javaid. Implementation of cloud computing for smes. *World Journal of Com- puter Application and Technology*, 2(3):66–72, 2014.
7. Sara Trigueros-Preciado, Daniel Pérez-González, and Pedro Solana-González. Cloud computing in industrial smes: Identification of the barriers to its adoption and effects of its application. *Electronic Markets*, 23:105–114, 2013.
8. Dario Assante, Manuel Castro, Ileana Hamburg, and Sergio Martin. The use of cloud computing in smes. *Procedia computer science*, 83:1207–1212, 2016.
9. G Tornatzky and M Fleischer. The processes of technological innovation, dc heath. & company, 1990.
10. Mohd Shahrul Nizam Mohd Danuri, Mohd Sazili Shahibi, and Mohd Razilan Abdul Kadir. The proposed of ict adoption foundation in malaysian agriculture.
11. Caetano Haberli Junior, Tiago Oliveira, and Mitsuru Yanaze. The adoption stages (evaluation, adoption, and routinisation) of erp systems with business analytics functionality in the context of farms. *Computers and electronics in agriculture*, 156:334–348, 2019.
12. Carina S González, Nazaret Gómez, Vicente Navarro, Mariana Cairós, Carmela Quirce, Pedro Toledo, and Norberto Marrero-Gordillo. Learning healthy lifestyles through active videogames, motor games and the gamification of educational activities. *Computers in human behavior*, 55:529– 551, 2016.
13. Omar Hasan Salah, Zawiyah Mohammad Yusof, and Hazura Mohamed. The determinant factors for the adoption of crm in the palestinian smes: The moderating effect of firm size. *PloS one*, 16(3):e0243355, 2021.
14. Sinfree Gono, G Harindranath, and Gül Berna Özcan. The adoption and impact of ict in south african smes. *Strategic Change*, 25(6):717–734, 2016.
15. Maryam Chavoshi11, Alex Tze Hiang Sim, and Jee Mei Hee. A crm adoption model for malaysian telecommunication and finance companies. 2015.
16. Wan Ismail Wan Muhammad. Application of toe framework in examining the factors influencing pre- and post-adoption of cas in malaysian smes. *International Journal of Information Technology and Business Management*, 49(1):26–37, 2016.
17. Steve Campbell, Melanie Greenwood, Sarah Prior, Toniele Shearer, Kerrie Walkem, Sarah Young, Danielle Bywaters, and Kim Walker. Purposive sampling: complex or simple? research case examples. *Journal of research in Nursing*, 25(8):652–661, 2020.
18. Ishan Senarathna, Carla Wilkin, Matthew Warren, William Yeoh, Scott Salzman, et al. Factors that influence adoption of cloud computing: An empirical study of australian smes. *Australasian Journal of Information Systems*, 22, 2018.
19. Mahyar Amini and Aryati Bakri. Cloud computing adoption by smes in the malaysia: A multi- perspective framework based on doi theory and toe framework. *Journal of Information Technology & Information Systems Research (JITISR)*, 9(2):121–135, 2015.